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How literal is the spatial metaphor in hypertext?

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Abstract

Two learning experiments investigated whether the spatial positioning of hyperlinks influences the recall of hyperlink position and of the hyperlinked information. The hyperlinks were semantically empty and were ordered in a four-by-four square (Exp. 1 and 2) or in a circle (Exp. 2). The information that was to be learned either was familiar (Exp. 1) or unfamiliar (Exp. 2) to the participants. The results showed that in an unfamiliar environment participants did not perform better than chance, but in a familiar environment they clearly recalled more hyperlinks on edge positions than in center positions. It is concluded that hyperlink position plays a subsidiary role in hypertext processing and helps to differentiate important from less important information.

Introduction

Hypertext users 'move through' virtual information spaces. Physically, they follow or click hypertext links. Cognitively, they keep track of what they are doing by observing and using a large number of landmarks and triggers, such as the labeling of hyperlinks, the location and perceptual attributes of links, the understanding of what they see and read, the knowledge of conventions of the digital medium, the remembrance of previous steps and many more. That way, users gradually discover how the information is partitioned in separate linkable pages, how these pages are related to each other and what the conceptual structure is of the complete environment. In other words, they incrementally construct a conceptual representation of the information space on the basis of a large number of conceptual and perceptual triggers.

The non-linearity of the hypertext task and the ephemerality of digital information, continuously turning up and leaving the screen make it plausible to assume that hypertext users invest considerably in 'locating' or 'positioning' the information presently processed within the overall structure of the information. As yet, hypertext research does not offer a satisfactory picture of this task, of the landmarks relevant in it and especially, of the literal or metaphorical nature of the task.

The use of spatial metaphors to refer to the core task of hypertext users has taken root in the world of hypertext documents. As Benyon states "Navigation of Information Space is not (just) a metaphor for HCI [Human-Computer Interaction]. It is a 'paradigm shift' that changes the way that we look at HCI" (2001:146). But does the users' task look like a spatial task, and how do they use literal space to execute their task? In an in-depth discussion of this issue, Boechler (2001) makes clear that a direct comparison with physical space is very problematic: there is no metric distance involved, the basic axioms of physical, Euclidean, space (minimality, symmetry, and triangle inequality) are not involved and there is no unequivocal way to define the spatial primitives of identity, location, magnitude, and time. Furthermore, hyperspace lacks the abundance of perceptual information that enables people in the real world to base their spatial decisions on. Compared to the real world, hyperspace is an impoverished environment. Nevertheless, studying hyperspace from a spatial perspective is a fruitful endeavor. Boechler concludes that "... it is important that we develop a detailed understanding of users' perceptions of hyperspace beginning with a thorough investigation of the most basic cognitive processes involved, processes that have been and continue to be closely examined with respect to many other types of environments and stimuli" (2001: 43).

The present study follows this conclusion and investigates the processing of hyperlinks at a very basic level, namely the level of the spatial layout of hyperlinks. The study aims at determining the contribution of spatial attributes of hyperlinks to the processing of digital information. In particular, it determines whether hyperlink positions on the screen affect the users' memory for the hyperlinks as well as the information they refer to.

The (spatial) processing of hyperlinks

Each of the information elements on a digital page can act as a hyperlink, a direct link to another page in the same information domain or away to another information domain or site. Often, links are collected in higher order webpages, menus or maps. Hypertext pages typically contain information in several modalities: text, graphics, images, video, and audio. Correspondingly, hyperlinks are constructs with multimodal characteristics: spatial (e.g., the location on the screen or in a configuration of links), perceptual (e.g., color, size, icons), semantic (e.g., the content of the label used), and pragmatic (e.g., the “I-have-been-here-before” color) (Maes, Van Geel, & Cozijn, 2006). They may all influence the processing, comprehension, and representation of hypertext. For a model of hypertext processing, it is desirable to establish, if possible, the independent contribution of each of these characteristics. The obvious approach to this endeavor is, of course, to start with the simplest characteristic, which is spatial information.

Although studies on hypertext abound, only few of them are directed to the investigation of the spatial characteristics of hyperlinks. In a recent, field experimental study, Murphy, Hofacker and Mizerski (2006) tested whether the serial position of hyperlinks in a list of links affected their clickability. The authors claim that users have a preference to start at the top of a list. However, in their experiments, space was confounded with content, as each link not only had a spatial position, but also a content label.. Moreover, space is only defined in terms of up and down, thereby clearly mirroring the normal old fashioned top-down reading process. Finally, the study is incomplete on crucial points.

Theories of spatial information processing, like the spatial framework theory (Franklin & Tversky, 1990), claim that the observer’s perspective has three dimensions: top-bottom, front-back, and left-right, with the first dimension dominating, followed by the front-back and the left-right dimension, respectively. Franklin and Tversky found evidence for this dominance in experiments where participants were probed for their memory of objects in an imagined space. This makes their findings relevant for hypertext, as hypertext too invites users to build a mental representation of the information space. Spatial information might very well be helpful in this respect.

In developing the experiments, we used a grid of 16 semantically empty hyperlinks organized along two dimensions: top-bottom and left-right, as these are the most basic and natural on a two-dimensional computer screen and in the website design practice¹.

Experiment 1

An information environment for future guides in a Dutch nature reserve for monkeys was constructed. The environment consisted of a description of 16 monkey species, unfamiliar to the average Dutch citizen, linked to the 16 identical hyperlinks in the link grid. The environment was database driven as to guarantee that the linking of information chunks and grid positions was completely random over participants.

Thirty-five students participated in the experiments, 14 male and 21 female, aged 18 to 25. It was made sure that the participants were versed in using hypertext and unfamiliar with the monkeys. The participants were asked to study the information about the monkeys as future guides in the nature reserve. They were instructed to learn the information about the monkeys one by one by clicking on the link in the grid that was active as indicated by a square around the link. For each participant the distribution of the monkeys over the 16 links in the grid, as well as the order in which the monkeys were to be learned was completely randomized.

The learning phase was followed by two tasks: an *answer task* and a *search task*. The *answer task* tested the memory for the information and consisted of 16 questions, each relating to a comparable detail of one of the 16 species descriptions (e.g., “which monkey has a ringed tail”). In the *search task*, the memory for the location of the information was tested. For each

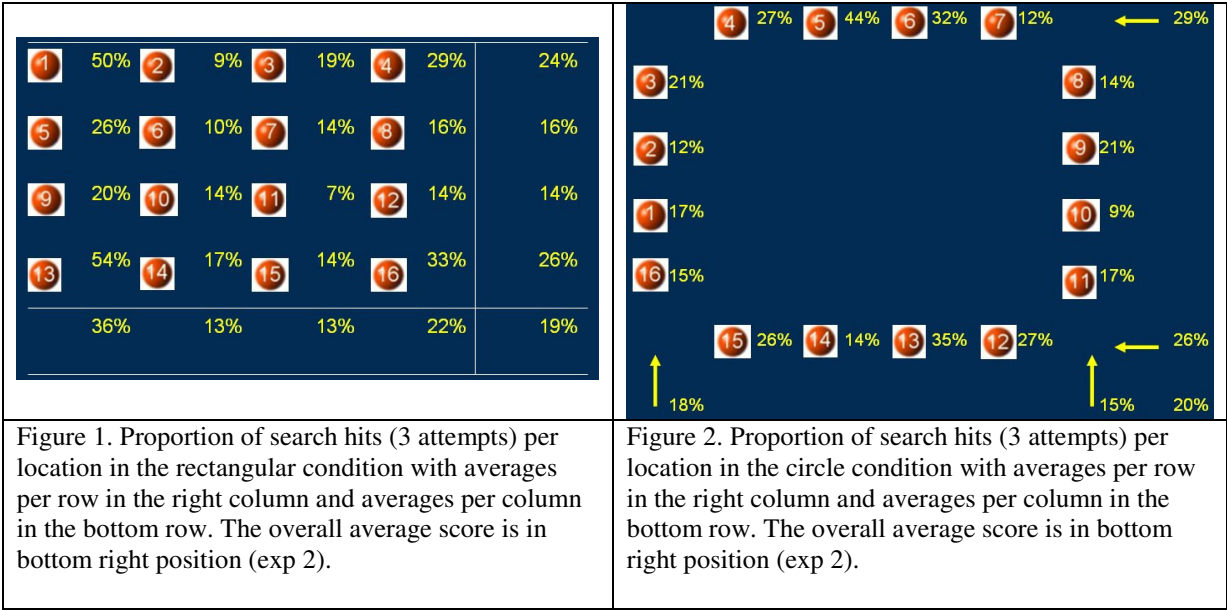
¹ But see the possibilities of front-back representations: www.cybergeography.org/atlas/web_sites.html.

monkey species, participants were asked to point out the location in the hyperlink grid. Participants were allowed three attempts to find the correct hyperlink in the grid. The order of the questions in both tasks was completely randomized per participant.

There was no effect of the position of the hyperlinks. In the answering task, 43% of the questions were answered correctly and the correctness of the answer was not related to the position of the answer in the grid. In the search task, 23% of the locations were found. Again there was no relation with the position of the information in the grid. Instead, two relevant search strategies could be discovered. Participants more often started searching in the left part of the grid, and they tended to stay in the vicinity of the first attempt at their second and third attempt. This is remarkable, as the results and the participants made clear that the participants really had no clue where to search for the answer. Apparently, they are inclined to stick to the same region instead of jumping around the grid. We concluded that the unfamiliarity with the information made learning the information too cognitively demanding to be sensitive for the possible effects we were interested in.

Experiment 2

In the second experiment the same instrumentation and procedure were used, but the cognitive demands on the participants were reduced by presenting familiar instead of unfamiliar information. The information environment consisted of 16 familiar sports, and each link described the general characteristics of one of them. Furthermore, one more hyperlink grid was added, i.e. a circular structure consisting of 16 hyperlinks. A characteristic of this structure is that it does not contain salient locations. Sixty-two participants were presented with either the rectangular or the circular grid.



The results of the participants having six or more positive hits in the search task were analysed (i.e., 18 in the rectangular and 12 in the circular condition). Participants answered 82% of the questions in the answer task successfully. However, their performance was not dependent on the type of sport, the type of grid, or the position within the grid. As figures 1 and 2 show, the position of the location was highly relevant in the search task. In the rectangular grid, the links on the left were hit more often than on the right, information on the salient positions (the edges of the rectangle) was found more often than on the other positions, the information in the top and bottom row was found more often than in the left and right rows. In the circular grid, the top

and bottom information was found more often than the left and right information. No differences in search hits were found between the two grid types, they performed equally well

Conclusion

The results of the second experiment support the notion that the top-bottom dimension dominates the left-right dimension, as suggested by Franklin and Tversky (1990). However, this dominance only pertained to the search task not to the answer task. It seems therefore that the position of the location makes a difference in finding the information, but not in remembering the information. Apparently, locations of hyperlinks are remembered independently of the information behind them. A possible explanation is that, in these experiments, there was no relation between hyperlink structure and information structure. In fact, the information was not structured at all. The experimental paradigm makes it possible to gradually introduce new perceptual or conceptual elements and to see how they influence the memory for location and information. The next step in this series of experiments is to introduce a conceptual structure in the information, e.g. clustering the sports four by four (bal sports versus water sports, etc.), and relate this structure to the hyperlink structure. The addition of this conceptual information, presented to the participants in advance, and either realized perceptually in the grid (in a four by four organisation), or not, enables us to further our understanding of the contribution of perceptual and conceptual triggers to the conceptualization and processing of hypertext.

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